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ABSTRACT

Previous studies in the area of testing frequency are scarce and outdated, but provide results showing that college students performance improves on objective tests when more frequent tests are given. The purpose of this study was to measure college students' performance on more frequent tests by reducing a unit of study into smaller segments, administering three short tests, and comparing results to those for one long test. Students' attitudes toward the more frequent tests and changes in study time were also measured. Results indicate that students prefer frequent tests, believe they are learning the material more thoroughly, and spend more time studying for them. Compared to students in the control group (given three short tests combined into one long test), the students in the experimental group improved their performance by 15.73 points--a result which was statistically significant beyond the .001 level. Results of this study, as well as the few other studies reported, support the benefits that may be gained by college students who are given the opportunity to improve their learning through the use of frequent tests. (Author/LMO)

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TEST FREQUENCY REVISITED

A PILOT STUDY

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Abstract

Previous studies in the area of testing frequency are scarce and outdated, but provide results showing that college students performance improves on objective tests when more frequent tests are given. The purpose of this study was to measure college students performance on more frequent tests by reducing a unit of study into smaller segments and administering three short tests and compare that to the results for one long test. Students attitudes toward the more frequent tests and changes in study time were also measured. Results indicate that students prefer frequent tests, believe they are learning the material more thoroughly, and spend more time studying for them. Compared to students in the control group (given three short tests combined into one long test), the students in the experimental group improved their performance by 15.73 points -- a result which was statistically significant beyond the .001 level. Since all results were found to be in favor of frequent tests, it is hoped that this research will revive experimentation in the area and will encourage college professors to utilize more frequent tests.

Test Frequency Revisited

A Pilot Study

Researchers concern for examining ways to improve college students performance has focused in many areas. One area that seems to have been neglected, however, is that of frequency of testing. In a review of college teaching, Kulik and Kulik (1979) assert that "frequent quizzing leads to improved student performance in college classes" (p. 85). Their assertions are based on several experimental studies conducted in the early 1930's and on one experimental study conducted in the early 1970's. Kulik and Kulik also refer to research conducted in relation to the Personalized System of Instruction (PSI). Research in this area has shown conflicting results, but leans more towards demonstrating increased student performance when more frequent tests are administered.

Testing students more frequently also seems to be more consistent with the way in which individuals store and process information. Many college students grades are based on only mid-terms and/or finals. When students are put into this type of testing situation, they can suffer from information overload as well as other factors affecting the processing of information. The material covered before a comprehensive exam may be initially improperly stored in short term memory leading to incorrect recall from long term memory. One way to reduce the problem of improperly stored information is to provide students with more frequent opportunities to assess their learning through the use of frequent tests.

Other short term memory issues that may affect students recall of excessive amounts of information are item decay and interference. "Item decay occurs when you fail to use information that you have learned, or when the

information you learned was not well rehearsed to begin with" (Goss, 1982, p. 34). Frequent testing would provide students with the avenue for using and rehearsing information throughout a semester by preceeding any type of long term, comprehensive exam. When students are presented with a comprehensive exam over several (4 to 5 units) of study, they are also faced with the problem of interference. "Interference occurs when the recall of one item is made more difficult because of the distraction of other things you are trying to remember as well" (Goss, 1982, p. 34). In instructional terms, the recall of one unit of instruction may interfere with the recall of a subsequent unit of instruction. When all the units are combined into a larger unit, "people can get confused if there is too much similarity between items that are remembered separately" (Goss, 1982, p. 34). If students are given the opportunity to learn by being tested over units (or even chapters) before proceeding to another unit, this might reduce the problem of recalling similar items.

As educators interested in improving student learning, we need to be aware of the ways in which we process, store, and recall information and design teaching methods which are consistent with our information processing capabilities. Also, as educators we need to be more enlightened in regard to the scant but conclusive research which supports the use of frequent testing procedures. In an attempt to revive research into an underdeveloped area of student performance, this research will focus on reviewing past findings and applying these findings to the design and implementation of a pilot study involving the use of frequent tests.

Previous Research

Previous research in testing frequency appears to have been begun by A. H. Turney in 1931. Turney was interested in discovering if students enrolled in an educational psychology class would perform better when given frequent opportunity to determine their relative grades or standing in the class and whether this knowledge motivated students to study harder. In other words, Turney was concerned with the effects of feedback on motivation. In his study, the experimental group was chosen during the first class meeting based on their lower average scores (22.9 points) obtained on an objective pretest covering the content of the upcoming semester. During the remainder of the semester, the experimental group was given 12 short quizzes, a mid-term exam, and a similar but new version of the pretest which represented the final examination. The control group took the same mid-term and final tests, but were not given the 12 short quizzes.

The gains in student learning were determined by adding the scores on the pretest and final examination together and substracting from that score the score on the pretest times two. Results indicated that the experimental group, when compared to the control group, gained 23 points out of an average score of 212 points. These gains led Turney to conclude that the 12 short quizzes motivated students in the experimental group (whose average was lower initially) to perform better overall than the control group.

After explaining the treatment conditions to the experimental group, the students completed a questionnaire which demonstrated that they preferred the short quizzes, studied more and harder because of the short quizzes, and believed that they had learned the subject matter more thoroughly. The

students also indicated that they did not feel worried or harassed by the frequent short quizzes. Overall, the students attitude toward being in the experimental group was very strongly in favor of the short quizzes.

Other research following Turney's includes Noel Keys' (1934) study of the influence of weekly (as opposed to monthly) tests on student learning and retention. Keys criticized Turney's research because the two groups differed widely in their initial knowledge of the subject as evidenced by their scores on the pretest. Therefore, Keys matched students enrolled in a educational psychology course according to sex and identical scores on a pretest consisting of 167 true/false items. The experimental group's treatment for the first two thirds of the semester consisted of weekly assignments and weekly tests (8 total). During this time, the control group received monthly and weekly assignments with two monthly exams. The content of the control group's monthly exams was identical to the experimental group's weekly tests.

Results showed that the experimental group's scores on the weekly tests exceeded the control group's scores on the monthly tests by 12%. In the third and final part of the semester, the experimental group received monthly assignments and a monthly exam. The control group received weekly assignments and an identical monthly exam. The experimental group's scores still exceeded the control group's scores, but the percentage was less (6%). In order to test retention, five weeks after the monthly test both groups were given an unannounced test which consisted of 118 true/false items from the original pretest. Again, the experimental group's retention scores exceeded the control group's scores by 7%. Also, on the total term scores, the experimental

group scores exceeded the control group scores by 8%. Thus Keys' research further supports the superiority of frequent tests on student learning and retention.

Nearly forty years after the Keys' study, David Dustin (1971) partially replicated it. According to Dustin (1971), his research differed from Keys (1934) research in the following ways:

> First, only the weekly assignment/weekly test and monthly test conditions were used. Second, instead of using two different sections meeting at different times, one section was randomly split in two, and the two groups met at the same time in different rooms for one class meeting each week. All tests were given at that meeting. Third, to make sure that any effects of the experimental and control procedures on the retention test would not be obscured by different treatments during the retention period, both groups received identical weekly exams during that period. (p. 410)

Dustin's experimental group's weekly exams were unannounced, while the control group's monthly exams were announced. The weekly and monthly tests contained identical multiple-choice questions, but no attempts were made to prevent the two groups from sharing testing information. Results of the weekly versus monthly exam scores indicated that the experimental group scored higher at the .05 level of significance for three of the four weekly tests. Retention test results showed that the experimental group scored higher at the .05 level of significance on one of the two retention tests.

Dustin's research also included an a priori measure of test anxiety to determine if frequent tests were causing students to be more nervous, worried, or afraid. Both groups were given four questions relating to anxiety directly before the second weekly exam and again before the fourth weekly exam (first monthly exam for the control group). While the mean anxiety scores for the experimental group (3.59) and the control group (3.69) first anxiety test showed differences which were not significant, for the second anxiety test, the experimental group's mean score dropped by .41 units while the control group's mean anxiety score rose by 1.51 units. Again, Dustin's research supports the use of frequent testing.

These three studies, Turney (1931), Keys (1934), and Dustin (1971) along with several other studies (Fitch, Drucker, & Norton, 1951; Hertzberg, Heilman, & Leuenberger, 1932) have demonstrated that frequent testing leads to improved performance for college students. A factor that may be operating to improve performance is the amount of feedback offered to students because of more frequent tests. In the studies by Fitch et al. (1951), Hertzberg et al. (1932), and Turney (1971), the subjects in the frequent exam conditions received a greater total number of exam questions and these questions were also used for class discussion. This feedback may have influenced their scores on subsequent testing by providing a practice effect. On the other hand, the Keys (1934) study controlled feedback by not discussing the exams in class. Since studies have been conducted in which feedback is controlled and uncontrolled, it seems safe to conclude that feedback helps students to improve their scores but does not entirely explain why student scores improve with frequent testing.

Another explanation as to why student scores improve under conditions of more frequent tests is that students pre-exam study behaviors may change when students are aware that they will be tested weekly as opposed to monthly or twice a semester. Dustin (1971) acknowledges that study time may increase when exams are given more frequently but he does not report any data in this area. Rather, he states that this is a variable that needs to be tested. Researchers involved with the PSI have reported that "students need more calendar days but not more total hours to complete PSI courses when number of quizzes was [were] increased" (Kulik & Kulik, 1979, p. 86). Since the previously cited studies have shown that students prefer more tests and are not overly anxious when given more tests, it seems safe to conclude that even if students do increase their study time because of more frequent tests, they are not complaining or being adversely affected by an increase in study time. In fact, as educators we should be more concerned with finding ways to increase students' studying habits in the hopes of improving overall performance.

Based on previous findings and explanations, the purpose of this research is to examine the effects of frequent testing on performance, student attitudes, and study time. The following research questions are proposed:

Q_1: When given the opportunity to be tested more frequently, do college students exam scores improve?

Q_2: When college students are tested more frequently, do their study habits change to show an increase in study time?

Q_3: How do college students feel (attitude) towards more frequent tests and do students feel like they retain more information when they are tested more frequently?

Method

Subjects

Subjects included two sections (out of 30 possible sections) of a Principles of Communication 1113 class taught at the University of Oklahoma during Spring semester 1984. The experimental section consisted of 24 students who met three days a week at 10:30 a.m. The control section consisted of 25 students who met three days a week at 1:30 p.m. Both sections were taught by the same Graduate Teaching Assistant and the researcher of this study. The unit of instruction studied during the experimental period consisted of five chapters related to public speaking. This unit represented the last of four units as predetermined by the standardized nature of the Communication 1113 class.

Procedures

The experimental group received lectures and three tests covering material from the textbook during six class periods. During five class periods, the control groups received the same lectures (as closely as possible) and a combined, scrambled form of the three short tests given to the experimental group. For further clarification of the experimental conditions see Figure 1.

Insert Figure 1 about here

Neither section was aware that they were being used as subjects in an experiment. The experimental group was told by their instructor that she had received special permission to test them differently from the way they had been tested over the previous three units of study. The students previous testing was conducted outside of class time in a Student Assessment Center (S.A.C)

and involved standardized compchecks used for all 30 sections of Communication 1113. These compchecks consist of 40 multiple choice items worth 30 points and an essay worth 20 points. The experimental section was given the option of taking all three short tests for a combined score or taking the regular Unit IV standardized compcheck. They were also told that the better score would be used in determining their final grade for the course. The students reacted favorably to the options and saw them as two chances to make the best possible grade.

The control group was told that due to problems with the computer graders in the S.A.C., they were going to be allowed to take the Unit IV test during class time. They were also told that the test would be constructed by their instructor and that they had the option of taking the instructor's test or the standardized Unit IV compcheck and that their best grade from either of these two exams would be used to determine their final grade for the course.

After students in the experimental group completed and turned in each of the three short tests, the answers were given out verbally by the instructor. Students were also given a slip of paper with their score during the next class meeting following each test. After all three tests had been taken, the experimental students were given their combined score based on 50 questions worth two points each. Students in the control group were also given a slip of paper with their test score written on it at the next class meeting following their taking of the 50 item test.

The experimental section completed a questionnaire designed to obtain information regarding study time for each of the three short tests; study time for previous standardized compchecks; preference for short tests;

learning gain from short tests; and testing frequency in other classes taken during the current semester. The control group completed a questionnaire designed to obtain study time for Unit IV test; study time for previous standardized compchecks; and testing frequency in other classes taken during the current semester.

Following the completion of the testing conditions, Cronbach's alpha reliability was computed for each of the three short tests and for the combined Test 4. Reliability was: Test 1 = .41; Test 2 - .07; Test 3 - 1.08; and Test 4 = .20. High reliability was not expected for these tests due to the small sample size taking the tests for the first time. "The test of reliability clearly is to use the measuring instrument more than once to measure the same object" (Anderson & Zelditch, Jr., 1975, p. 330).

The researcher had considered pre-testing the tests by having other sections of Communication 1113 take the tests, but felt the risk of exposing the experimental conditions was too great due to the "grapevine" that exists between all sections of the Communication 1113 program. Instead of taking this exposure risk, graduate assistants previewed the tests and offered suggestions. A test similar to Test 4 of this experiment had been used in the previous semester as an extra credit exam. Item difficulty results were used to eliminate questions which were poorly written or were answered correctly by the majority of the 13 students who had taken the extra credit exam. In other words, several efforts were made to increase the reliability before administering the tests under the experimental conditions.

Results

Existing class differences

Computation of class averages for both the experimental and control groups were done on the previous three standardized compchecks. Mean and median differences based on only the objective portion of the standardized compchecks may be found in Table I.

Table I

Existing Differences

	EXPERIMENTAL GROUP		CONTROL GROUP	
	Mean	Median	Mean	Median
Compcheck I	71.96	73.00	67.28	65.00
Compcheck II	72.50	75.00	71.96	73.00
Compcheck III	74.92	75.00	67.92	68.00
Average scores	73.13	74.33	69.06	68.66

Differences in experimental groups favor:

Mean = 4.07 Median = 5.67

Results indicate that the experimental group exceeded the control group in their initial test taking ability. Reliability data for these standardized compchecks was not available.

Experimental versus control groups

Class mean scores were used to compute differences. Table 2 shows the results for research question one according to mean, median, and standard deviation for each of the three short tests given to the experimental group and for the combined Test 4 given to the control group.

Table 2

Experimental versus control

	EXPERIMENTAL GROUP				CONTROL GROUP		
	Mean	SD	Median		Mean	SD	Median
Test 1	80.42	6.90	80.00				
Test 2	79.66	11.40	79.90				
Test 3	93.30	14.87	93.30				
Combined	80.93	1.30	84.40	Test 4	64.20	9.13	58.00

Differences in Experimental Group's Favor:

Mean = 15.73 SD = 1.915 Median = 21.50 $t = 8.217$, $p > .001$

The experimental group scores exceeded the control group scores on the combined test by 15.737 points. These experimental-control groups scores were found to be statistically different at the .001 level. If the experimental group's higher average score on the three previous standardized compchecks are taken into account, the experimental group still exceeds the control group by 11.667 points.

Study Time

Results from the questionnaires administered to test research question two (changes in amount of study time for more frequent testing) are as follows. All hours and minutes are computed as an average per person score. Students in the experimental section reported studying 1½ hours for Test 1; 1¼ hours for Test 2; and between 3/4 of a hour to one hour for Test 3. For all three short tests, the average study time per person equalled 3½ hours.

In order to get a basis for comparison, the experimental section was asked to estimate their study time for each of the three previous standardized compchecks. The results indicated that the experimental students usually spent an average of 2 and 3/4 hours studying for standardized compchecks. Therefore, the experimental students each spent approximately 3/4 of an hour more when studying for the three short tests as compared to a unit exam.

In contrast, the control group was asked to estimate the amount of time spent studying for Test 4 and for each of the three previous standardized compchecks. Results indicated that the control group spent an average of 3 hours per person studying for each of the standardized compchecks. When comparing the results of study time for both experimental and control groups, it was found that the experimental group spent an average of 3½ hours for the three short tests compared to the control group spending an average of 3 hours studying for the combined three tests. Study time differences between the two classes indicate that the experimental section usually spent 2 and 3/4 hours studying for the standardized compchecks while the control group usually spent 3½ hours studying for the same exams. Overall, the study time results indicate that the experimental group spent more time studying under frequent testing conditions when compared to previous testing conditions and when compared to the control group's study time for the combined Test 4.

Attitude and Retention

On the questionnaire, the experimental group was asked to indicate their preference for the shorter, more frequent tests. The mean score obtained was 4.54 on a 5-point scale ranging from "definitely no" to "definitely yes". Sixteen of the 24 students selected the "definitely yes" option.

The questionnaire also asked the experimental students if they thought the shorter tests helped them to learn the subject matter more thoroughly. On a 3-point scale (1=No; 2=Not sure; 3=Yes), the obtained mean was 2.83. Twenty-two out of 24 students responded "yes".

An additional question designed to give the researcher some idea as to the frequency of testing in other college courses was asked of both the experimental and control groups. Out of 89 classes in which the 24 members of the experimental group were concurrently enrolled, students reported 30 classes giving either three or four tests per semester. The range of frequency for testing was from zero to 13 tests per class. Out of 82 classes which members of the control group were taking during the same semester, 38 classes gave four tests per semester followed by 22 classes giving three tests per sememster. The range of frequency was from zero to seven tests per class. Based on these preliminary results (120 out of 171 classes giving either three or four tests per semester) it appears that most college students grades are based on three to four tests per semester.

Discussion

The statistically significant differences found in this study are consistent with previously mentioned studies. Turney (1931) reported an almost .001 level of significance (actually 99.75 chances out of 100) (p. 761). Keys (1934) reported differences at the .001 level on all tests except for one unannounced final exam in which the chances were only 53 out of 100 (p. 432). Dustin (1971) reported experimental-control differences to be statistically significant at the .05 level (p. 412). In all of these studies the sample size was much larger and experimental conditions were used throughout an

entire semester. Since the present study was conducted only as a pilot study for one of four units of instruction, differences between the experimental and control groups might be expected to increase even more were high reliability obtained on the testing instruments and were the experiment repeated for an entire semester.

Another reason for repeating this type of study is to incorporate some type of retention measure. Both Keys (1934) and Dustin (1971) considered this variable and the results were quite impressive. Using a measure of retention was considered for this study, but due to the options offered to the students, especially the experimental group, the researcher decided not to force students into further participation. The issue of higher retention is intriquing and should spark interest for future research. As educators, we should be concerned with ways to improve learning and this study, as well as other studies, suggest one means for accomplishing this type of learning objective.

College students attitudes toward more frequent testing are positive. This study, as well as the other studies cited, show that students are not threatened or made overly anxious by more frequent testing conditions. In fact, more frequent tests seem to motivate students to spend more time studying. From the results of the questionnaire accompanying this research, it was discovered that students in the more frequent testing condition studied on an average per person basis 3/4 of an hour more for the three short tests when compared to testing conditions during the semester preceeding the experiment. There was also a drop in study time from the first test to the third test. This may be explained by the shorter lengths of the second

and third tests or by student adjustments to instructor testing style. The experimental section spent approximately 1/2 hour more studying for the three short tests when compared to the control group's study time for the combined three tests. The fact that the experimental students spent more time studying may explain their gains over the control group. However, from study time results, we also see that the experimental section spent less time (2 3/4 hours) than the control group (3½ hours) studying for the previous standardized compchecks. If we assume that study time leads to better performance, this assumption will not explain the two classes initial differences on class average scores for standardized compchecks. Due to these conflicting results for study time, it seems safe to conclude that while students do study more for frequent tests, other factors may be operating to influence overall improved test performance.

If both students attitude and retention support more frequent testing, we might want to question why the opportunities for frequent testing are not more abundant then they were found to be in this study. As reported earlier, out of 171 college courses, 120 offered from three to four tests per semester. Of these 171 courses, 16 offered two or less tests and 35 offered 5 to 13 tests, with calculus classes offering the most tests. One reason explaining why college courses do not offer more tests is the time involved. More frequent tests require more preparation time by the instructor and require more class time for administering and returning tests. These two disadvantages do not seem, however, to outweigh the advantages gained by students improved test performance.

Another explanation is the lack of instructor knowledge as evidenced by the lack of research in the area of testing frequency. A diligent search under many areas of education and psychology journals failed to produce research in this area except for what has been reported in this study. And, in this study the most current research cited was done in 1971 some 13 years ago. It is all too clear that the area of testing frequency deserves more attention. The positive results of this study as well as the few other studies reported support the benefits that may be gained by college students who are given the opportunity to improve their learning through the use of frequent tests.

Limitations

This study has demonstrated that frequent testing leads to improved test performance for college students. While the results are strong, as in any research, the study has its limitations. The positive attitudes expressed by the experimental group may be due to the students wanting to please their instructor for the extra time and work involved in presenting them with the option of the short tests. Also, they may have responded positively because the tests were given during class time while prior to the experiment the students were required to take the standardized compchecks in the Student Assessment Center outside of class time.

Another limitation is the low reliability of the tests. Replication of the study could resolve this problem. Having used only one unit of instruction out of four units may be considered by some to be a limitation. The researcher acknowledges this limitation, but believes that the experiment's short time period allowed the results of changes in study time to be reported more

accurately. Since this variable had not been studied in previous research, it was important to try and control other factors which may effect study time.

A final limitation recognized by the researcher is the difference between class sections in initial test scores as measured by previous standardized compchecks. While future research should try to obtain classes with equal average test scores, the results still demonstrate that frequent testing improves college students performance on objective tests.

Conclusion

The results of this pilot study have clearly reinforced previous findings in the area of test frequency. The experimental group's gain from taking three short tests compared to the control group's combined long test was statistically significant beyond the .001 level. The experimental group's positive attitude toward the short tests are also supportive of the use of frequent tests. Students reported spending more time studying under the frequent testing conditions but this should be a goal that we should strive to maintain in the hopes of improving college students study habits. Preliminary findings regarding the use of frequent tests in college courses point to the need for further research in this area and suggest that college teachers need to be more informed as to the effects that the use of frequent tests have on college students performance.

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Figure 1

Experimental Conditions

Class period	Treatment	Class period	Treatment
1	Lecture- 1½ chapters	1	Lecture- 1 chapter
2	Lecture- ½ chapter	2	Lecture- 1 chapter
	Test 1 (2 chapters) (20 item M/C)		
3	Lecture- 1½ chapters	3	Lecture- 2 chapters
	Test 1 results		
4	Lecture- ½ chapter	4	Lecture- 1 chapter
	Test 2 (2 chapters) (15 item M/C)		
5	Lecture- 1 chapter	5	Test 4 (5 chapters) (50 item M/C)
	Test 2 results		
6	Test 3 (1 chapter) (15 item M/C)	6	Test 4 results
	Questionnaire		Questionnaire
7	Test 3 results and combined score		